

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C. 20231
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 10 August 2000 (10.08.00)	
International application No. PCT/US99/27731	Applicant's or agent's file reference 1797.016PC01
International filing date (day/month/year) 23 November 1999 (23.11.99)	Priority date (day/month/year) 23 November 1998 (23.11.98)
Applicant LI, Yin-Ming et al	

1. The designated Office is hereby notified of its election made:

☒

in the demand filed with the International Preliminary Examining Authority on:

21 June 2000 (21.06.00)

☐

in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was☐

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
 34, chemin des Colombettes
 1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

F. Baechler

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 16 MAR 2001

WIPO

PCT

14

Applicant's or agent's file reference 1797.016PC01	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US99/27731	International filing date (day/month/year) 23 NOVEMBER 1999	Priority date (day/month/year) 23 NOVEMBER 1998
International Patent Classification (IPC) or national classification and IPC Please See Supplemental Sheet.		
Applicant LI. YIN-MING		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets.
- ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 0 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 21 JUNE 2000	Date of completion of this report 17 FEBRUARY 2001
Name and mailing address of the IPEA-US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer <i>Dorthea Lawrence</i> MEDINA A. IBRAHIM Telephone No. (703) 308-0196

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/27731

I. Basis of the report1. With regard to the **elements** of the international application:*☐ the international application as originally filed☒ the description:

pages 1-14 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

☒ the claims:

pages 15-17 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

☒ the drawings:

pages 1-2 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

☒ the sequence listing part of the description:

pages NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:☐ contained in the international application in printed form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. ☒ The amendments have resulted in the cancellation of:☒ the description, pages NONE☒ the claims, Nos. NONE☒ the drawings, sheets 4/4 NONE5. ☐ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

**Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/27731

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO
Inventive Step (IS)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO
Industrial Applicability (IA)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO

2. citations and explanations (Rule 70.7)

Applicants response to the PCT Written Opinion of 19 October 2000 filed on 14 December has been fully considered and was found partly persuasive. The objection to claims 6, 10, 14-15 under PCT Article 33(3) has been withdrawn.

Claims 1-5, 7-9, 11-13, and 16 lack an inventive step under PCT Article 33(3) as being obvious over Chaney et al (US Pat# 5,711,784) in view of Salt et al (Bio/Technology Vol. 13, 1995).

Applicants traverse that the references cited by the Examiner are silent regarding the existence and ability of any *Thlaspy caerulescens* plant to accumulate in the amounts claimed. Applicants continue that Chaney et al discloses Ni and Co extraction with Alyssum species, and merely indicate that *T. caerulescens* accumulates high levels of Zn and Cd. Salt et al, who dismisses the use of *T. caerulescens* because of its slow growth rate, fails to identify *T. caerulescens* subspecies. These arguments have been considered but not found persuasive.

Chaney et al disclosed a method for recovering heavy metal from soil by using metal accumulator, and suggested the use *T. caerulescens* species for ZN and Cd. Salt et al has shown in their field trials that *T. caerulescens* has accumulated high levels of Zn and Cd. It is unclear how much weight Salt et al has given the amount of Zn and Cd accumulated by the plant. It is obvious to one of ordinary skill in the art to utilize the method for phytorecovering metals from soil as taught by Chaney et al, and to modify that method by incorporating the *T. caerulescens* species that was shown to tolerate high ZN and Cd taught by Salt et al. Given the motivation from Chaney et al of *T. caerulescens*' ability to tolerate high levels of Zn and Cd in the shoots, a person skilled in the art would have been motivated to use the claimed plant for the phytoremediation of soils contaminated with Zn and Cd with a reasonable expectation of success as taught by Salt et al. Therefore, claims 1-5, 7-9, 11-13, and 16 lack an inventive step under PCT Article 33(3).

(Continued on Supplemental Sheet.)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/27731

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

CLASSIFICATION:

The International Patent Classification (IPC) and/or the National classification are as listed below:

IPC(7): C21B 9/00; C22B 9/00; AO1H 3/02, 5/00; AO1G 1/00 and US Cl.: 75/710; 800/276, 260; 210/602, 681, 682

V. 1. REASONED STATEMENTS:

The report as to Novelty was positive (YES) with respect to claims 1-16.

The report as to Novelty was negative (NO) with respect to claims NONE.

The report as to Inventive Step was positive (YES) with respect to claims

6, 10, 14-15

The report as to Inventive Step was negative (NO) with respect to claims 1-5, 7-9, 11-13, 16.

The report as to Industrial Applicability was positive (YES) with respect to claims 1-16.

The report as to Industrial Applicability was negative (NO) with respect to claims NONE.

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):

Claims 1-5, 7-9, 11-13, and 16 lack an inventive step under PCT Article 33(3) as being obvious over Raskin et al (US Pat# 5,364, 451) and Cunningham (US Pat# 5,320, 663) in view of Salt et al (Bio/technology, Vol. 13, 1995, as stated in the last Written Opinion for claims 1-16.

Applicants traverse that the method by Raskin et al teaches away from the use of non-crop plants for phytoremediation; Cunningham et al discloses phytoremediation of lead containing soils with *Ambrosia* and *Apocynum*, and Salt et al does not disclose the amount of Zn and Cd accumulated in the claimed method. These arguments are not found persuasive.

To make a case of obviousness, it is not required by each reference to disclose all claim limitations. All that is required is the combination of the cited references to teach or reasonably suggest the claimed invention with reasonable expectation of success. In this case, each of Raskin et al and Cunningham disclose phytoremediation of metal contaminated soils with a Brassicaceae plant and *Ambrosia*/*Apocynum* sp respectively. Raskin et al did not preferably use a non-crop related plants such as *T. caerulescens* as argued by the Applicants. However, Salt et al identified the plant as the "best metal accumulator identified", as agreed by the Applicants, and have shown in their field trials that *T. caerulescens* has accumulated high levels of Zn and Cd. Therefore, the claimed invention as whole would have been obvious over the combination of Raskin et al and Cunningham (US Pat# 5,320, 663) with Salt et al.

Claims 1-16 meet the criteria set out in PCT Article 33(2) and (4), because the prior art does not teach a method for recovering Cd and/or Zn from contaminated soil by cultivating at least one *Thlaspy caerulescens* that accumulates 15,000-3000mg Zn/Kg and/or 1000-6000mg Cd/Kg above ground tissue on dry wt basis, and wherein said plant have the industrial applicability for recovering pure Cd and Zn, and/or for reducing toxic metals in the environment.

Claims 6,10, 14-15 meet the criteria set out in PCT Article 33(3), because the prior art does not teach the claimed method that uses the identified *T. caerulescens* cultivar.

----- NEW CITATIONS -----

NONE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/27731

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C21B 9/00; C22B 9/00; A01H 3/02, 5/00; A01G 1/00

US CL : 75/710; 800/276, 260; 210/602, 681, 682

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 75/710; 800/276, 260; 210/602, 681, 682

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,711,784 A (CHANEY et al.) 27 JANUARY 1998 (27/1/1998), see entire document, especially column 3, lines 18-25.	1-16
Y	US 5,320,663 A (CUNNINGHAM) 14 JUNE 1994 (14/6/94), see entire document, especially columns 3-6, and 12.	1-16
Y	US 5,785,735 A (RASKIN et al.) 28 JULY 1998 (28/7/98, see entire document, especially columns 3-6.	1-16
Y	US 5,364,451 A (RASKIN ET AL) 15 NOVEMBER 1994 (15/11/94), see entire document, especially columns 5 and 8.	1-16

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	* & * document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

09 FEBRUARY 2000

Date of mailing of the international search report

07 MAR 2000

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/27731

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X - Y	SALT et al. Phytoremediation: A Novel Strategy for the Removal of Toxic Metals from the Environment Using Plants. Bio/Technology. May 1995, Vol.13, pages 468-474, especially pages 469-471.	1-2, 7,9, 11-13, 16 ----- 3-6, 8, 10, 14, 15
Y	US 5,711,784 A (CHANEY et al.) 27 JANUARY 1998 (27/1/98), see entire document.	1-16
Y,P	US 5,928,406 A (SALT et al.) 27 JULY 1999 (27/7/99), see entire document, especially columns 5-7 and 12-14	1-16
Y,P	US 5,944,872 A (CHANEY et al.) 31 AUGUST 1999 (31/8/99), see entire document.	1-16

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US99/27731

B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

STN CAS, DIALOQ, WEST1.2a

TERMS: PHYTOEXTRACTION, PHYTOMINING, PHYTOREDUCTION, ZINC, CADMIUM, ZINC-CONTAINING
ORE, CADMIUM-CONTAINING ORE, THLASPI CAERULESCENS